ANALYSIS

24(102), March - April, 2020

ISSN 2321–7359 EISSN 2321–7367

Medical Science

Prevalence of postoperative surgical-site infection in Al-Madinah

Mohamed K. Zaky[1]✉, **Mohammad A. Albokhari**[2], **Turki K. Albouq**[2], **Yasser M. Alharbi**[2], **Mohammed W. Tolah**[2], **Ali A. Alshareef**[2]

[1]Department of Surgery, College of Medicine, Taibah University, Almadinah Almunawwarah, Saudi Arabia
[2]College of Medicine, Taibah University

✉**Corresponding author**
Professor of Surgery, Consultant General and Laparoscopic Surgery, Department of Surgery, College of Medicine, Taibah University, Almadinah Almunawwarah, Saudi Arabia
Email: m_kzaki@yahoo.com

Article History
Received: 03 November 2019
Reviewed: 04/November/2019 *to* 17/December/2019
Accepted: 18 December 2019
E-publication: 02 January 2020
P-Publication: March - April 2020

Citation
Mohamed K. Zaky, Mohammad A. Albokhari, Turki K. Albouq, Yasser M. Alharbi, Mohammed W. Tolah, Ali A. Alshareef. Prevalence of postoperative surgical-site infection in Al-Madinah. *Medical Science*, 2020, 24(102), 639-646

ABSTRACT

Objective: The study was done to evaluate the prevalence of surgical site infection (SSI) in the government hospitals in Madinah, and to identify the relative risk factors that may contribute to its occurrence. *Methods:* This is a retrospective cross sectional study that was conducted in 3 main government hospitals in Madinah, Saudi Arabia; King Fahad, Ohud and Al-Ansar hospitals during the period between 1/10/2017 to 31/12/2017. The studied sample included 300 patients in different specialties, (General surgery, Orthopedics, ENT, Urology and Ophthalmology). *Result:* The study revealed that 11 cases (3.67%) out of 300 surgeries developed SSI. The prevalence of SSI was equal in Ohoud and KFH hospitals (4%), but it was lower in Alansar hospital (3%). Moreover, Urology

ranked first in the rate of SSI (10%), whereas other specialties had lower prevalence of SSI as follows; ENT (6.89%), Orthopedic (3.03%) and General Surgery (2.68%). Among the risk factors studied, Diabetes Mellitus (DM), overweight and obesity showed significant association with SSI (P-value= 0.0017, P-value = 0.047 and P-value = 0.023) respectively. *Conclusion:* In this study the prevalence of SSI in three main hospitals in Al-Madinah within 3 months period was (3.67%), which is comparable to other studies. There was statistically significant correlation between diabetes, overweight and obesity and SSI, whereas the correlation to other studied risk factors was statistically non-significant.

Keywords: Surgical-site infection, Post-operative infection, Surgery, Madinah

1. INTRODUCTION

Surgical site infections (SSI), or as known as postoperative wound infection, is one of the most important causes that complicate patients recovery. Also, it increases the mortality and morbidity in hospitals. The Center for Disease Control and Prevention (CDC) defined it as any infection that typically occur in the first 30 days of an operation at the site of the operation or the body part where it took place, or in case of an implant within a year and the infection is most likely thought to be caused by the surgery (Horan et al., 1992; Borchardt and Tzizik, 2018). It is estimated that SSI occur following 1-3% of the overall surgical procedures and is responsible for nearly 2% of the deaths secondary to the health care-associated infections (HAIs) (Magill et al., 2014; Garner and Anderson, 2016). Every year, more than 230 million major surgical procedures are conducted worldwide according to the World Health Organization (WHO) with evidence shows that 0.4-0.8% of all these procedures, patients die as a result of the procedure itself. Patients experience major complications following approximately 3-16% of all surgical procedures with SSI on the major complication list. This equates to nearly 1 million deaths and another 6 million disabilities annually worldwide (Barie and Wilson, 2015).

One study in the United State of America USA showed that HAIs along with SSIs cost nearly $3.2 billion a year (Zimlichman et al., 2013) Also in the USA, SSI is found to be a serious complication with an incidence of 2-5% in patients undergoing surgery (Darouiche, 2013). A recent study about the reasons for hospital admissions following surgery in USA showed that the most common cause of unplanned readmissions was SSI (Merkow et al., 2015). In developing countries, the higher rates of SSI are not surprising and much effort is required to decrease the burden of this problem (Asaad and Badr, 2016). SSI can have a major impact on the health care system in Saudi Arabia. Recently, one study was conducted in King Khalid University Hospital which showed that nine patients out of one hundred and thirty one patients included in the study showed evidence of sepsis (6.8%), with higher rates of infection in those with diabetes or having emergency operation compared to others. The bacteria most commonly isolated were: *E. coli, Pseudomonas aeruginosa* and *Staphylococcus aureus* (Khairy et al., 2011; Frey et al., 2019).

This study aims at identifying the magnitude of the problem and the risk factors that contribute to SSI in the hospitals of Al-Madinah. Three major hospitals: King Fahad hospital, Ohud hospital and Al-Ansar hospital were included in this study to investigate the prevalence of SSI.

2. MATERIALS AND METHODS

This retrospective cross sectional study included 3 main hospitals in Al-Madinah, Saudi Arabia; King Fahad Hospital (KFH), Ohud Hospital and Al-Ansar Hospital, during the period between 1/10/2017 to 31/12/2017. The study was approved by Taibah University College of Medicine research ethical committee and an informed consent was obtained from the Ministry of Health in Al-Madinah regarding access to medical record departments at the mentioned hospitals. The sample size was 300 patients (100 patients from each hospital randomly selected among those who underwent surgical procedures and were admitted to surgical wards: General Surgery, Orthopedics, ENT, Urology, and Ophthalmology).

The data was collected from medical records which included the patient demographic data and diagnostic criteria as collected by the treatment team. The data included associated risk factors (comorbidities, smoking, body mass index, gender, type of surgery and admission duration). Each patient's data was assessed from the time of admission till discharge from the hospital and also on follow-up visits at the OPD which extended up to 30 days. SSIs were diagnosed according to the guidelines of the Centers for Disease Control and Prevention (CDC) Atlanta 1999. A patient in which at least one of the following was observed is considered positive for SSI: Purulent drainage, with or without laboratory evidence from the surgical incision, organisms isolated from an aseptically obtained culture of fluid or tissue from the incision, at least one of the signs or symptoms of infection like pain, tenderness, swelling, redness or heat along with positive culture and finally a diagnosis of SSI by the surgeon or attending physician (Berríos-Torres et al.,

2017; Allen-Bridson et al., 2017). The study objectives were to determine the Prevalence of SSI and to identify the risk factors of post-operative infection in Al-Madinah, Saudi Arabia. Data were collected on a datasheet (Microsoft Excel) then analyzed by The Statistical Package for the Social Sciences (SPSS) software (word version 16.0). Qualitative data were expressed using numbers and percentage, and data was analyzed using Chi square ($\chi 2$) to detect association between variables, regarding the P-value (<0.05 was considered statistically significant).

3. RESULTS

After data analysis, the sample was found to be randomly collected from five different departments (General surgery, Orthopedics, ENT, Urology and Ophthalmology) in the three hospitals. The majority of the sample was from General Surgery department (49.66%); While the other cases from Orthopedic, ENT, Urology and Ophthalmology were (33%, 9.66%, 6.67%, 1%) respectively (Figure 1).

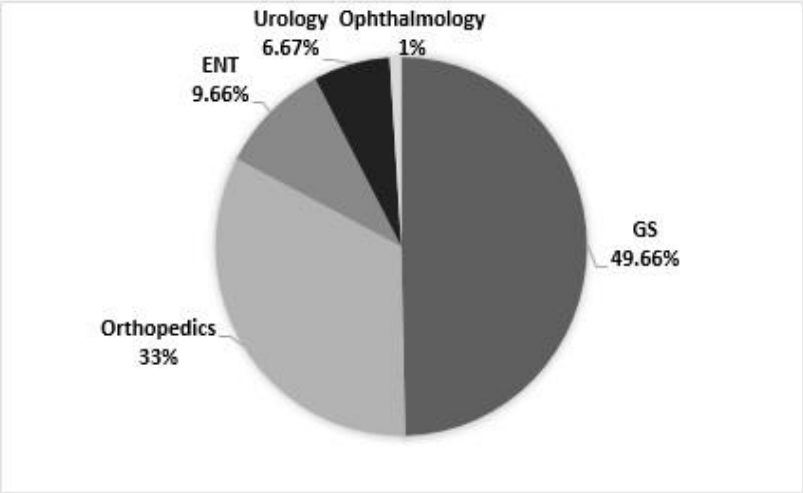

Figure 1 shows the distribution of total sample regarding different departments

Out of 300 cases, 240 were males (80%) and 60 were Females (20%). Regarding their nationalities, the majority of the patients were Saudi (84.33%) while the Non-Saudi patients accounted for (15.66%). The mean age was 35.99 ± SD 19.31. The study revealed that 11 out of 300 surgical cases had SSI with infection rate of (3.67%). The rate of SSI was analyzed regarding each hospital which showed that cases with SSI was 3 out of 100 cases in Al-Ansar hospital (3%), and 4 out of 100 cases in KFH as well as Ohud Hospital (4%) (Figure 2).

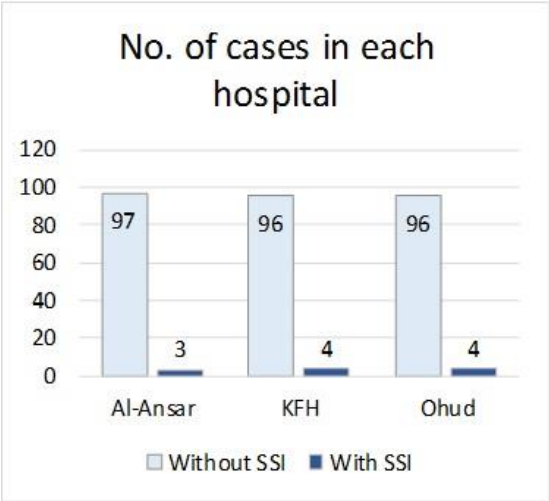

Figure 2 shows the number of cases in each hospital.

The rate of SSI was analyzed regarding the association between surgical procedure and the rate of infection. Among all surgical procedures, there was higher rate of infection with IM nail removal, pharyngeal abscess drainage and cyst excision with a rate of (33.33%) (Table 1).

Table 1 Types of surgical procedures, number of cases and the percentage of each.

Surgical Procedure	Total No. of cases	No. of infected cases	Percentage %
Knee surgery	14	2	14.28%
IM nail removal	3	1	33.33%
Renal stones	15	2	13.33%
Tonsillectomy	4	1	25%
Pharyngeal abscess drainage	3	1	33.33%
Appendectomy	32	2	6.25%
Hernia	19	1	5.26%
Cyst excision	3	1	33.33%

Table 2 Correlation between risk factors and incidence of SSI

Variable		SSI		Chi-Square	P-value
		Yes	No		
Gender	Male	8	232	0.377	0.539
	Female	3	57		
Nationality	Saudi	9	244	0.055	0.815
	Non-Saudi	2	45		
BMI	Less than 18.5 (underweight)	1	1	1.014	0.314
	18.5 - 25 (normal weight)	1	112	1.177	0.617
	25 - 30 (overweight)	5	54	3.937	0.047
	More than 30 (obese)	1	6	11.381	0.023
	Not specified	3	116	2.301	0.129
Comorbidities	DM	6	41	13.06	0.0017
	HTN	3	58	0.339	0.560
	Heart disease	0	11	0.435	0.510
Smoking	Smoker	6	88	2.86	0.091
	Not smoker	5	201		
Department	ENT	2	27	0.846	0.358
	General Surgery	4	145	0.808	0.369
	Urology	2	18	0.433	0.111
	Ophthalmology	0	3	0.000	0.999
	Orthopedic	3	96	1.093	0.895

After data analysis, the only significant risk factors for SSI were found to be DM (P-value = 0.0017), Overweight (P-value = 0.047) and obesity (P-value = 0.023). Other risk factors and comorbidities were found to be statistically non-significant (P-value >0.05) (Table 2).

4. DISCUSSION

Despite the improvements in the prevention methods, SSIs remain a major clinical issue as they are responsible for significant mortality and morbidity, which is reflected on the demands of healthcare systems (Jenks et al., 2014). In this study, 300 cases were collected from 3 main hospitals in Almadinah (100 cases from each hospital). The sample was collected randomly from 5 surgical specialties (General surgery, Orthopedics, ENT, Urology and Ophthalmology) during the period 1/10/2017 to 31/12/2017. Out of the 300 surgical cases, 11 cases developed SSI. The result of SSI in the study was 3.67%, which was comparable to previous studies that showed the prevalence of SSI to range from 5-30 % (Carvalho et al., 2017; Kumar and Rai, 2017; Pathak et al., 2014). The rate of SSI reported in the current study was lower than that reported in a previous similar study done at King Saud University Hospital, Riyadh, Saudi Arabia, which showed that out of one hundred and thirty one patients recruited in the study, nine patients developed SSI (6.8%) (Khairy et al., 2011).

By comparing the results, the infection rate in King Saud University Hospital was higher, which could be attributed to several factors. One of the factors that might have affected their result was the time of the study which was conducted during the year of 2007. Another factor was the duration of their study which was 9 months, while the duration of our study was 3 months. Finally, the sample of their study was taken from one hospital, while this study sample was taken from three different hospitals. All cases were taken from surgical departments with the majority being from General Surgery department 149 cases. Other departments were: Orthopedics 99 cases, ENT 29 cases, Urology 20 cases, and finally Ophthalmology 3 cases. Out of the 300 cases, a total of 11 cases developed SSI. Out of the 149 General Surgery cases, 4 cases developed SSI (2.68%). There were different types of operations with two cases of Appendectomy (6.25%), one case of Hernia (5.26%), and one case of Cyst Excision (33.33%). Out of the 99 Orthopedics cases, 3 cases developed SSI (3.03%). Two of them following knee surgery (14.28%) and one case after IM nail removal (33.33%). On the other hand, the ENT department had two cases of SSI (6.89%). One of them was after tonsillectomy (25%) and the other was following pharyngeal abscess drainage (33.33%). Finally, the Urology department, which had also two cases of SSI (10%), both following renal stone surgery (13.33%). Regarding the Ophthalmology department, there were 3 total cases (3%) with no SSI (0%).

By analyzing the association between the type surgical procedure and the rate of infection, there were 3 cases of each (IM nail removal, pharyngeal abscess drainage and cyst excision) with one case of SSI from each of them. The infection rate was 33.33% regarding each type of surgical procedure. This is a higher rate compared to the other types of surgical procedures as shown in Table 1. Other studies showed that the site of surgery as well as the type of surgery is affecting the postoperative infection rate (Özmen et al., 2016; Jeong et al., 2013; Shahane et al., 2012).

Regarding Body Mass Index (BMI), we found that out of the 11 cases, 5 cases were overweight (45.45%) and 1 case was obese (9.09%). While 1 case was normal weight (9.09%), 1 case was underweight (9.09%) and in 3 cases the weight was not specified (27.27%). This proved that being overweight or obese is a major risk factor for SSI (P-value = 0.047) and (P-value = 0.023) respectively. Lawson et al. (2013) concluded that patients with normal BMI (18.5-24.9) had a lower rate of SSI when compared to overweight and obese patients (Lawson et al., 2013). Any BMI of (>30 kg/m^2) is in direct proportion to the rate of SSI (Segal et al., 2014).

Also, in the current study, a trial to correlate the incidence of SSI to other comorbidities showed a statistically significant correlation between DM and SSI (P-value = 0.0017). Out of the 11 cases that developed SSI, six patients (54.54%) were diabetic. The incidence of SSI among all diabetic patients involved in this study was (12.76%). The same correlation between DM and SSI was reported in other studies (Lawson et al., 2013; Segal et al., 2014; Alfonso-Sanchez et al., 2017; Lovecchio et al., 2014; Martin et al., 2016).

Looking at the smoking as a possible risk factor, 6 cases out of 94 smoker have SSI with no significant association (P-value = 0.091) although other studies have shown smoking to be a major risk factor for SSI (Durand et al., 2013). Other comorbidities studied in the study sample like Hypertension and Heart Disease showed no statistically significant correlation with SSI. (P-value = 0.560 and = 0.510 respectively). As regards gender, out of the 300 cases of the study sample, 240 (80%) were Males, while the Females were 60 (20%). The study showed that out of the 11 cases of SSI, 8 of them were males with an infection rate of (3.33%). While the other 3 cases were females with an infection rate of (5%). Although the infection rate in females was higher than males, it was statistically non-significant (P-value = 0.539). This gender-related difference in SSI rate is comparable to those reported in the study conducted at King Saud University Hospital, which reported a higher SSI among female patients in their study (7.8%), when compared to male patients (6.4%) (Khairy et al., 2011).

Regarding surgical wounds classification, out of the 11 cases of SSI, 5 cases (45.45%) were clean wounds, 5 cases (45.45%) were clean contaminated wounds, and 1 case (9.09%) was infected wound. Other researches have shown that clean wounds have lower

risk of developing SSI, while clean contaminated, contaminated and infected wounds have higher risk of SSI (Ortega et al., 2012; Spagnolo et al., 2013; Onyekwelu et al., 2017).

Finally, According to the results, diabetes, overweight and obesity were the main significant risk factors for SSI among the sample taken from the three main hospitals in Al-Madinah. So, here are some of the CDC guidelines on how to prevent SSI: Appropriate use of proper antibiotics in the perioperative period according to the procedure, implementing perioperative glycemic control and use blood glucose target levels less than 200 mg/dL in patients with and without diabetes, maintaining perioperative normothermia, maintaining adequate oxygenation and performing intraoperative skin preparation with an alcohol-based antiseptic agent (Berríos-Torres et al., 2017; Rogers 2017).

Limitation

While conducting the research, the main limitation encountered was the deficiency in recording the microbiological assessment with type of organism for cases with SSI. Which reflected on the result of the study as it was intended to know the most common causative organism.

5. CONCLUSION

The result of this study showed a rate of SSI to be (3.67%) among three main hospitals in Al-Madinah within 3 months period. Also, there was a significant association between diabetes, overweight and obesity in relation with increased rate of SSI. Other possible risk factors and comorbidities were found to be statistically non-significant.

Ethics approval

This study was ethically approved by Research Ethics Committee, College of Medicine, Taibah University, Almadinah Almunawwarah, Saudi Arabia, with the following ID (PEP4-G4).

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author's Contributions

Mohamed K. Zaky, Mohammad A. Albokhari, Turki K. Albouq, Yasser M. Alharbi, Mohammed W. Tolah and Ali A. Alshareef have made substantial contribution in the conception and design of this study, collecting, analyzing and interpretation of data, writing and revising of the initial and final drafts. All authors approved the final version of the manuscript and are responsible for the similarity index of the content of this study.

Acknowledgment

The authors highly appreciate the cooperation of Taibah University, Medical College, the Modified Program and PEP track. The authors also appreciate the Research Ethics Committee in Taibah University and in Ministry of Health. Also, we appreciate all hospitals directors and medical record departments for their cooperation and facilitation of the resources for our study at King Fahad hospital, Ohud hospital and Al-Ansar hospital.

Abbreviations

(SSI): Surgical site infection

(CDC): Centers for disease control and prevention

(WHO): World Health Organization
(HAIs): health care-associated infections
(KFH): King Fahad Hospital
(BMI): Body mass index
(OPD): Outpatient clinic
(DM): Diabetes mellitus
(IM): Intramedullary

REFERENCE

1. Alfonso-Sanchez JL, Martinez IM, Martín-Moreno JM, González RS, Botía F. analyzing the risk factors influencing surgical site infections: the site of environmental factors. *Can J Surg*. 2017; 60(3):155–161.
2. Allen-Bridson K, Gross C, Anttila A, Brooks J, Hebden J, Leaptrot D et al. Health care-associated infections studies project: An American Journal of Infection Control and National Healthcare Safety Network data quality collaboration. American Journal of Infection Control. 2017; 45(12):1394-1395.
3. Asaad AM, Badr SA. Surgical Site Infections in Developing Countries: Current Burden and Future Challenges. *Clin Microbiol*. 2016; 5: e136.
4. Barie PS, Wilson SE. Impact of evolving epidemiology on treatments for complicated skin and skin structure infections: the surgical perspective. *J Am Coll Surg*. 2015; 220(1):105–116.
5. Berríos-Torres S, Umscheid C, Bratzler D, Leas B, Stone E, Kelz R et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. *JAMA Surgery*. 2017; 152(8):784-791.
6. Borchardt R, Tzizik D. Update on surgical site infections. Journal of the American Academy of Physician Assistants. 2018; 31(4):52-54.
7. Carvalho R, Campos C, Franco L, Rocha A, Ercole F. Incidence and risk factors for surgical site infection in general surgeries. Revista Latino-Americana de Enfermagem. 2017;25: e2848.
8. Darouiche R. Surgical site infections - Infectious Disease Advisor. 2019.
9. Durand F, Berthelot P, Cazorla C, Farizon F, Lucht F. Smoking is a risk factor of organ/space surgical site infection in orthopaedic surgery with implant materials. *Int Orthop*. 2013; 37(4):723–727.
10. Frey P, Marti G, Droz S, de Roche von Arx M, Suter-Riniker F, Aujesky D et al. Bacterial colonization of handheld devices in a tertiary care setting: a hygiene intervention study. Antimicrobial Resistance & Infection Control. 2019; 8(1).
11. Garner B, Anderson D. Surgical Site Infections. *Infectious Disease Clinics of North America*. 2016; 30(4):909-929.
12. Global Guidelines for the Prevention of Surgical Site Infection. Geneva: World Health Organization; 2018. Available from: https://www.ncbi.nlm.nih.gov/books/NBK536404/ [Accessed: 25 June 2019].
13. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol*. 1992; 13(10):606–608.
14. Jenks P, Laurent M, McQuarry S, Watkins R. Clinical and economic burden of surgical site infection (SSI) and predicted financial consequences of elimination of SSI from an English hospital. *Journal of Hospital Infection*. 2014; 86(1):24-33.
15. Jeong S, Ann H, Kim J, Choi H, Kim C, Han S et al. Incidence and Risk Factors for Surgical Site Infection after Gastric Surgery: A Multicenter Prospective Cohort Study. Infection & Chemotherapy. 2013; 45(4):422.
16. Khairy G, Kambal A, Al-Dohayan A, Al-Shehri M, Zubaidi A, Al-Naami M et al. Surgical Site Infection in a Teaching Hospital: A Prospective Study. Journal of Taibah University Medical Sciences. 2011; 6(2):114-120.
17. Kumar A, Rai A. Prevalence of surgical site infection in general surgery in a tertiary care centre in India. *International Surgery Journal*. 2017; 4(9):3101-3106.
18. Lawson EH, Hall BL, Ko CY. Risk factors for superficial vs deep/organ-space surgical site infections: implications for quality improvement initiatives. *JAMA Surg*. 2013; 148(9):849–858.
19. Lovecchio F, Beal M, Kwasny M, Manning D. Do Patients with Insulin-dependent and Noninsulin-dependent Diabetes Have Different Risks for Complications after Arthroplasty. *Clin Orthop Relat Res*. 2014; 472(11):3570-3575.
20. Magill S, Edwards J, Bamberg W, Beldavs Z, Dumyati G, Kainer M et al. Multistate Point Prevalence Survey of Health Care Associated Infections. New England Journal of Medicine. 2014; 370(13):1198-1208.
21. Martin E, Kaye K, Knott C, Nguyen H, Santarossa M, Evans R et al. Diabetes and Risk of Surgical Site Infection: A

Systematic Review and Meta-analysis. Infection Control & Hospital Epidemiology. 2016; 37(1):88-99.
22. Merkow R, Ju M, Chung J, Hall B, Cohen M, Williams M et al. Underlying Reasons Associated With Hospital Readmission Following Surgery in the United States. *JAMA*. 2015; 313(5):483-495.
23. Onyekwelu I, Yakkanti R, Protzer L, Pinkston CM, Tucker C, Seligson D. Surgical Wound Classification and Surgical Site Infections in the Orthopaedic Patient. *J Am Acad Orthop Surg Glob Res Rev*. 2017; 1(3):e022.
24. Ortega G, Rhee D, Papandria D, Yang J, Ibrahim A, Shore A et al. An Evaluation of Surgical Site Infections by Wound Classification System Using the ACS-NSQIP. Journal of Surgical Research. 2012; 174(1):33-38.
25. Özmen T, Javadov M, Yeğen CS. Factor's affecting surgical site infection rate after elective gastric cancer surgery. *Ulus Cerrahi Derg*. 2016; 32(3):178–184.
26. Pathak A, Saliba EA, Sharma S, Mahadik VK, Shah H, Lundborg CS. Incidence and factors associated with surgical site infections in a teaching hospital in Ujjain, India. *Am J Infect Control*. 2014; 42(1):e11-15.
27. Rogers SO. Surgical Perspective: Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection 2017. *Surg Infect (Larchmt)*. 2017; 18(4):383-384.
28. Segal CG, Waller DK, Tilley B, Piller L, Bilimoria K. An evaluation of differences in risk factors for individual types of surgical site infections after colon surgery. *Surgery*. 2014; 156(5):1253–1260.
29. Shahane V, Bhawal S, Lele U. Surgical site infections: A one year prospective study in a tertiary care center. *Int J Health Sci (Qassim)*. 2012; 6(1):79–84.
30. Spagnolo AM, Ottria G, Amicizia D, Perdelli F, Cristina ML. Operating theatre quality and prevention of surgical site infections. *J Prev Med Hyg*. 2013; 54(3):131–137.
31. Zimlichman E, Henderson D, Tamir O, Franz C, Song P, Yamin C et al. Health Care–Associated Infections. JAMA Internal Medicine. 2013; 173(22):2039-2046.